

Semantics

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Overview of the NLP Lectures

- Introduction to natural language processing (NLP).
- Regular expressions, sentence splitting, tokenization, part-of-speech tagging.
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- Language models <https://eduassistpro.github.io/>
- Vector semantics.
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- Parsing.
- Semantics.
 - Lexical semantics.

Semantic Analysis

- Meaning representation: formal structures to represent the meanings of linguistic utterances.
- Semantic analysis: the process of constructing and assigning meaning representations to linguistic inputs.

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Meaning Representations

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s
analysis

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I have a car.



Lexical Semantics

- Lexical semantics: linguistic study of word meaning.
- Key questions:
 - What is the
 - Most words <https://eduassistpro.github.io/>
 - How are the meanings of different related?
 - Specific relations between senses.
 - *Vehicle* is more general than *car*.
 - Semantic fields.
 - *travel* is related to *flight*.

Terminology

- **Wordforms**: any form of a word.
 - good, better, best, decide, decided.
- **Lexeme**: an abstract representation of a word and corresponds to a set of all its forms.
 - RUN = {run, r
- **Lemma**: a particular grammatical form used to represent a lexeme. This is often called the base form.
 - book, car, fly
- **Word sense**: a discrete representation of one aspect of the meaning of a word.

Lemmatization

- Map a wordform to a lemma.
 - Countries -> country
 - Europe -> Europe

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- Tools:
 - <https://eduassistpro.github.io/>
 - <http://nlp.stanford.edu/software/> Add WeChat edu_assist_pro
 - <http://textanalysisonline.com/nltk-wordnet-lemmatizer>

WordNet

- Very large lexical database of English.
 - 117k nouns, 115k verbs, 21k adjectives, and 4k adverbs.
- **Synset**: the set of near-synonyms for a sense.
 - 82k noun synsets, 13k verb synsets, 18k adj. synsets, 3k adv. synsets.
 - Avg. # synse <https://eduassistpro.github.io/> adj. 1.4, adv. 1.25
- Website : <http://wordnet.princeton.edu/>
- WordNet in other language <https://eduassistpro.github.io/>, Italian ...

Knowledge Bases (Open Linked Data)

(Bob_Dylan, **compose**,
Like_a_rolling_stone")

(The_Dark_Night, **directedBy**,
Christopher_Nolan)

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Entity
Graph

OpenIE
(Ollie,
Reverb)



Economic
Graph

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- Parsing.
- Semantics.
 - Lexical semantics.
 - Compositional semantics.

Compositional Semantics

- Principle of compositionality.

The meaning of a complex expression is determined by its structure and the meanings of its constituents.

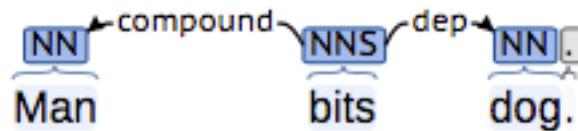
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- Examples:

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OR



Challenges for NNs

- Variable lengths of sentences.

Dog bites man.

The man saw the dog with the telescope.

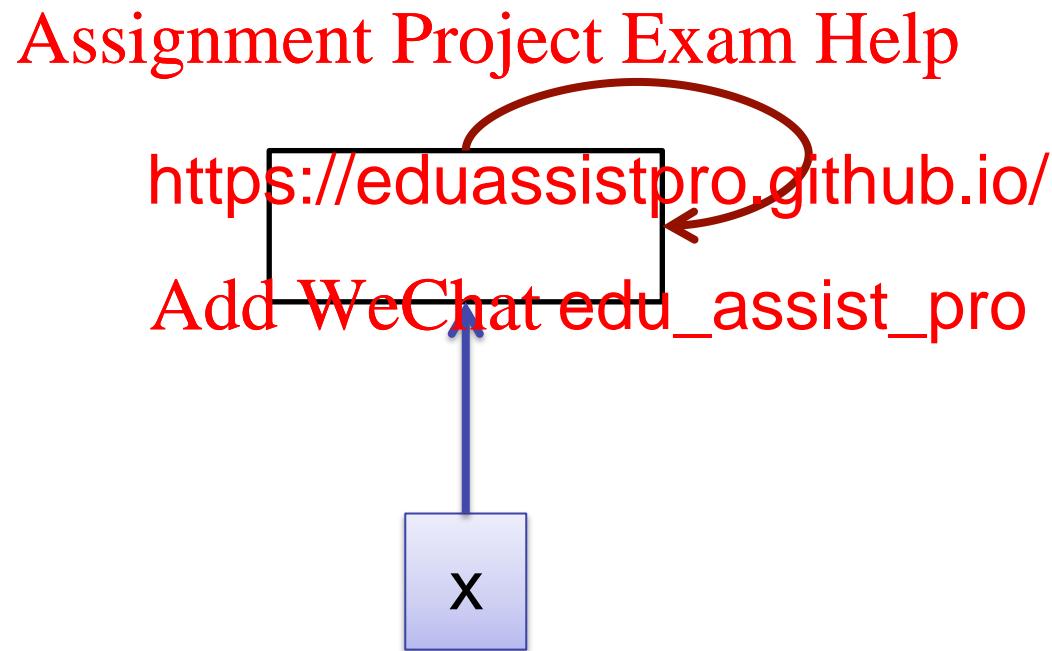
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- Variable synt

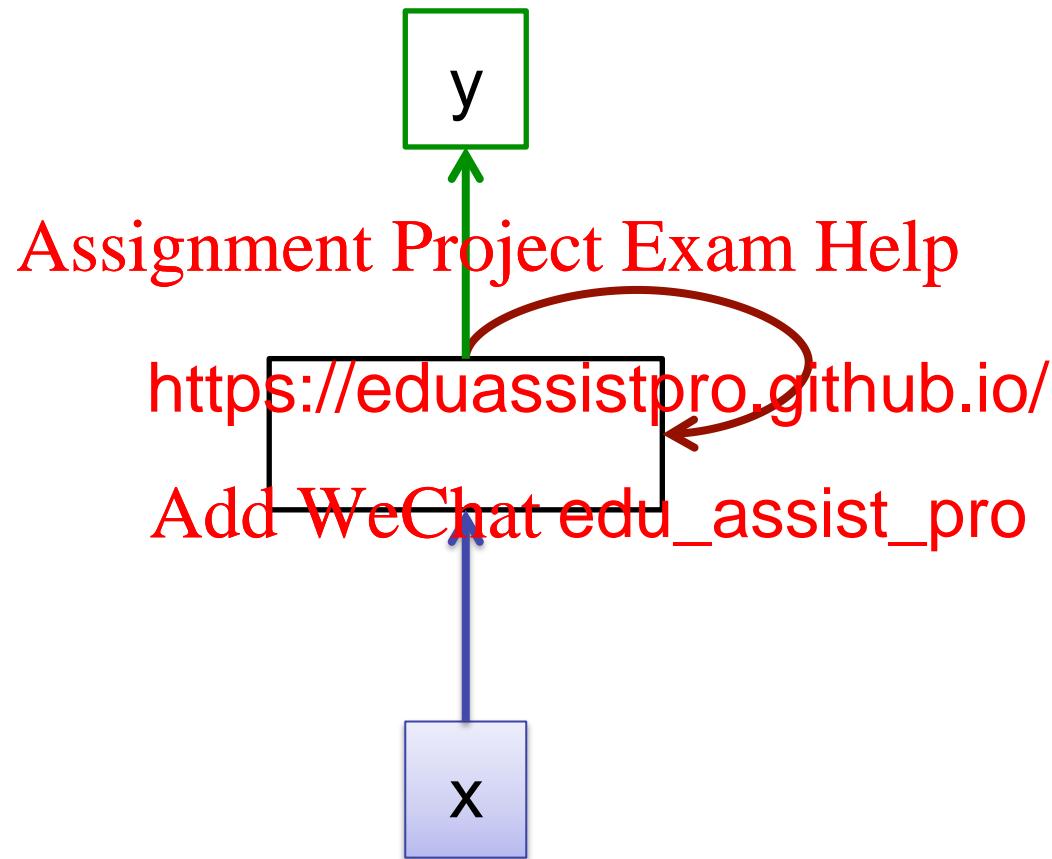
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Recurrent Neural Networks



Recurrent Neural Networks



Recurrent Neural Networks

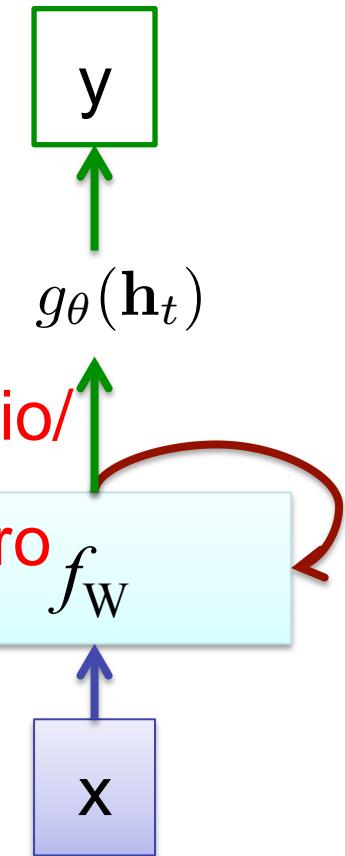
$$\mathbf{h}_t = f_{\mathbf{W}}(\mathbf{h}_{t-1}, \mathbf{x}_t)$$

new state Assignment Project Exam Help

$$\mathbf{y}_t = g_{\theta}(\mathbf{h}_t)$$

label at time t

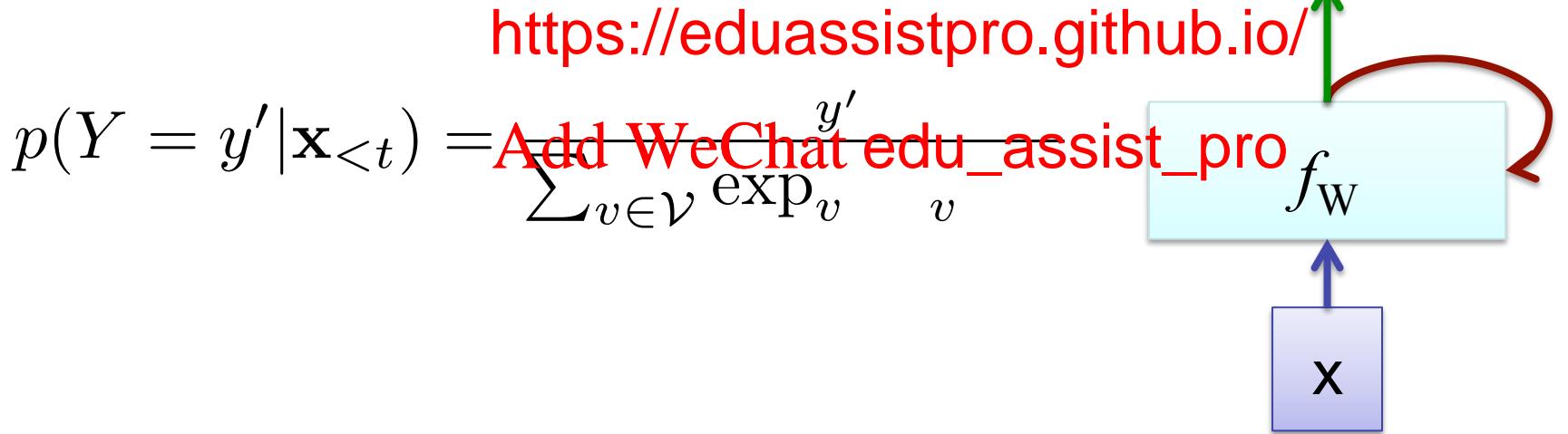
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Vallina RNN for Word Prediction

$$\mathbf{h}_t = \tanh(\mathbf{W}_h \mathbf{h}_{t-1} + \mathbf{W}_x \mathbf{x}_t)$$

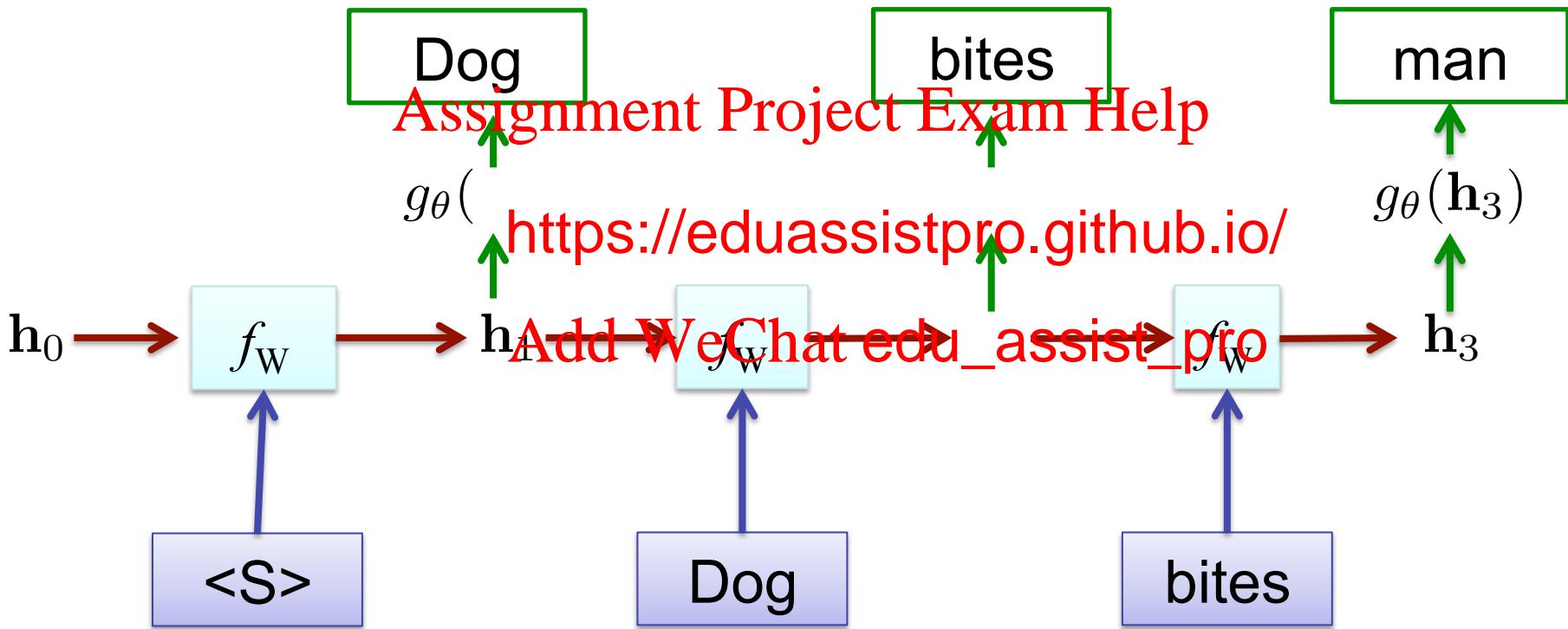
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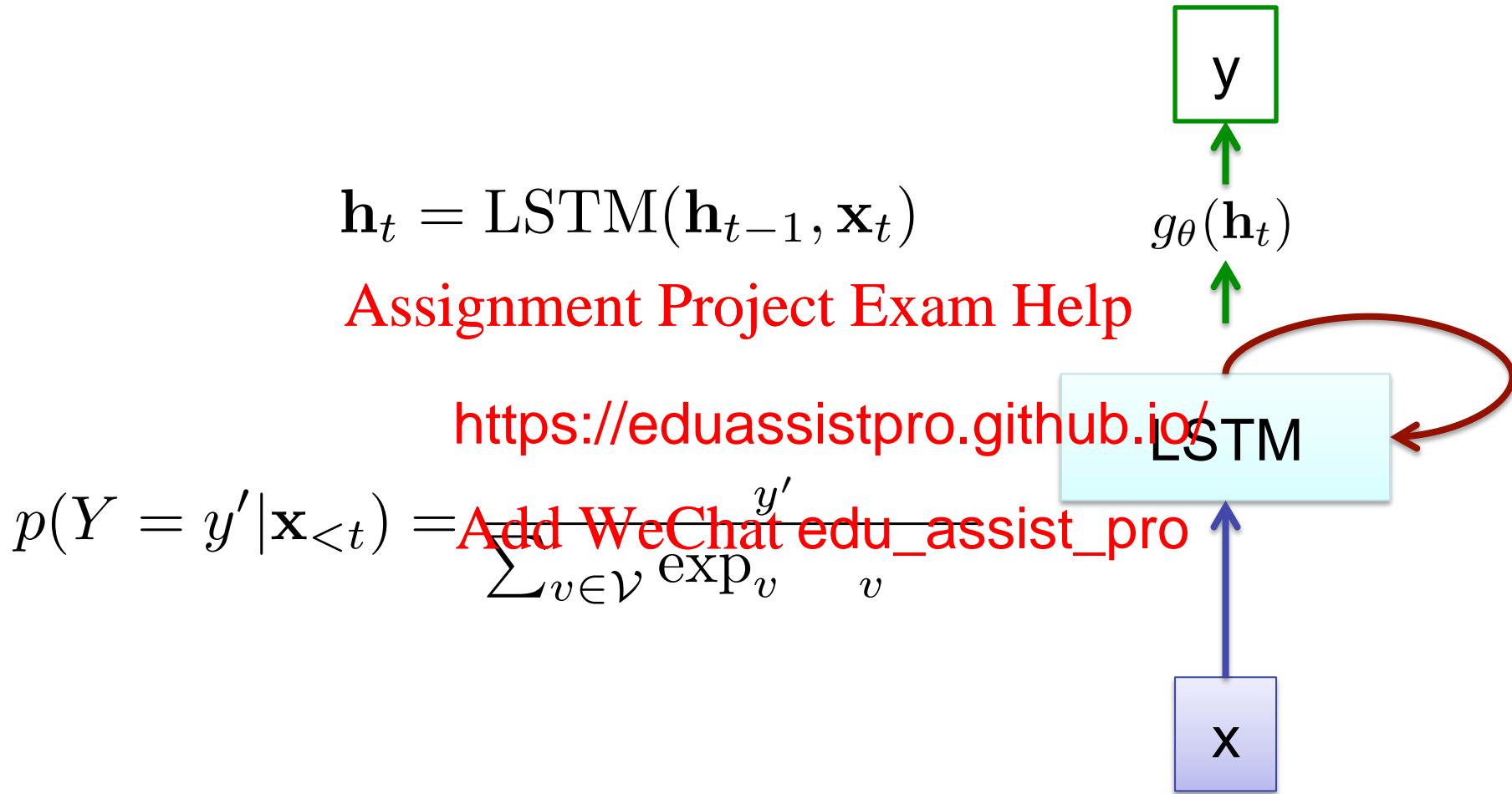
Vallina RNN for Word Prediction

$$\mathbf{h}_t = \tanh(\mathbf{W}_h \mathbf{h}_{t-1} + \mathbf{W}_x \mathbf{x}_t)$$

$$p(Y = y' | \mathbf{x}_{<t}) = \frac{\exp(\mathbf{w}_{y'}^T \mathbf{h}_t)}{\sum_{v \in \mathcal{V}} \exp_v(\mathbf{w}_v^T \mathbf{h}_t)}$$



Long Short Term Memory and GRU [1,2,5]



Recursive Neural Networks [3,4]

$$\mathbf{h}_p = f_{\mathbf{W}}(\mathbf{x}_{lc}, \mathbf{x}_{rc})$$

parent

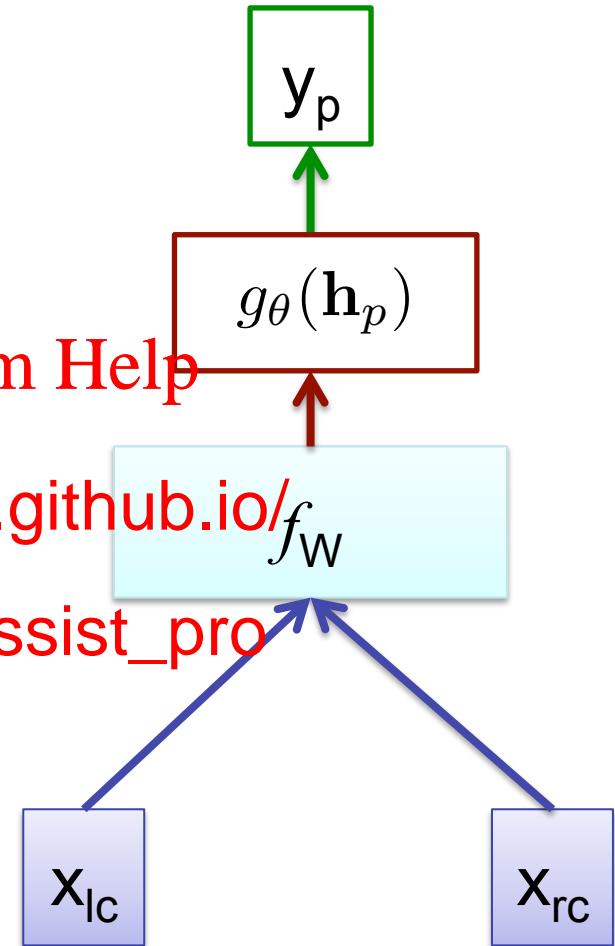
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left child

right child

$$\mathbf{y}_p = g_{\theta}(\mathbf{h}_p)$$

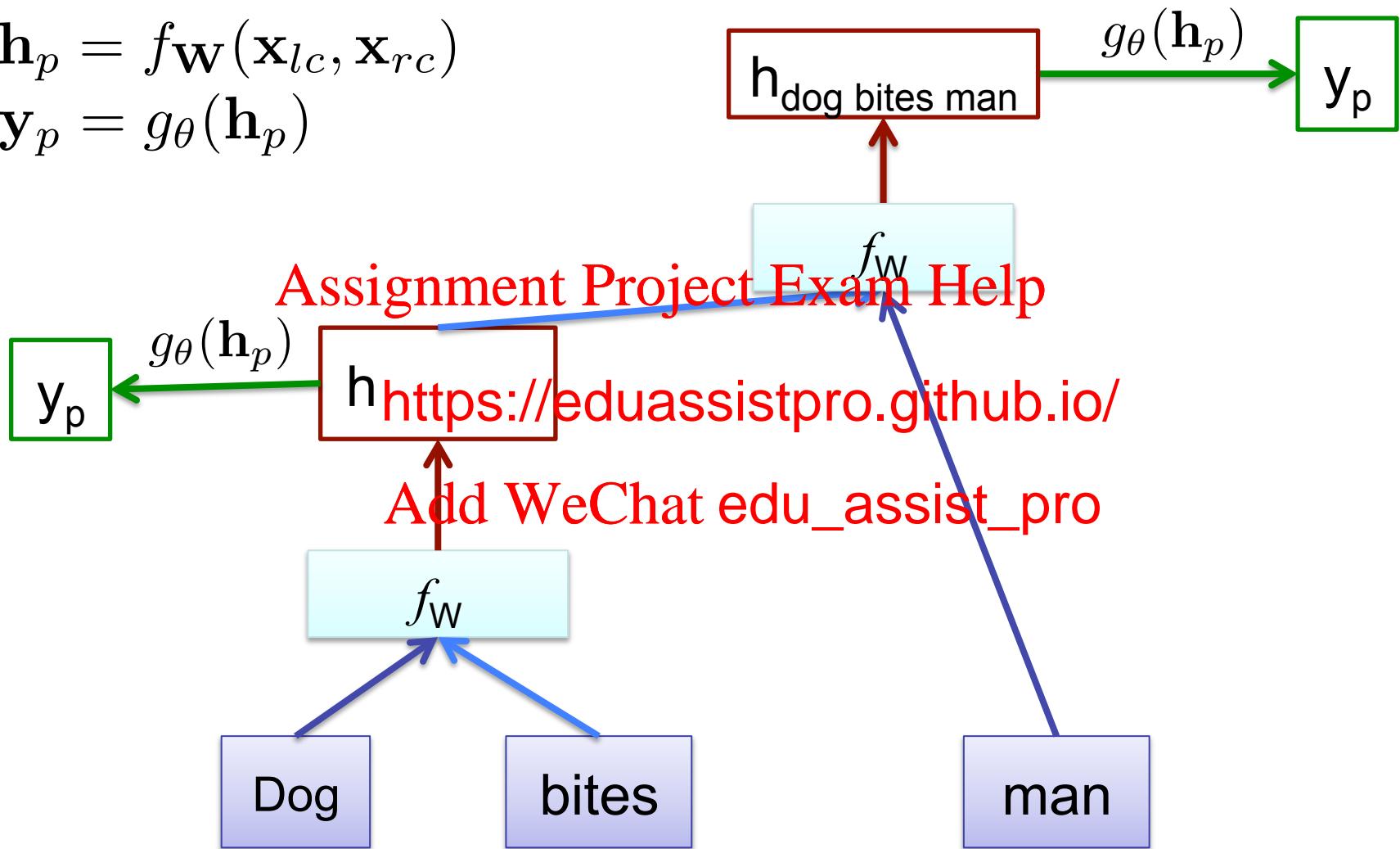
label of parent node



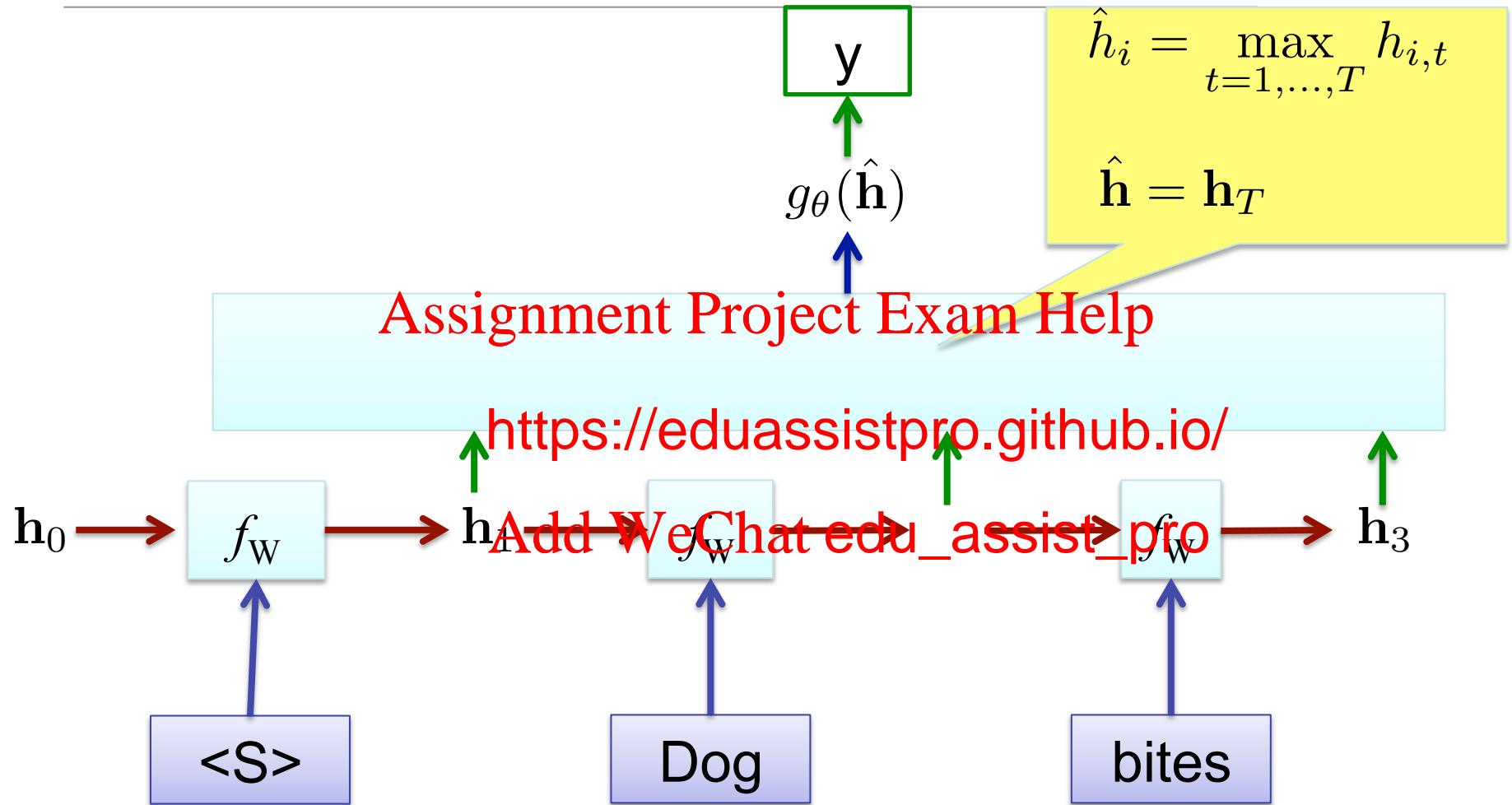
Recursive Neural Networks [3,4]

$$\mathbf{h}_p = f_{\mathbf{W}}(\mathbf{x}_{lc}, \mathbf{x}_{rc})$$

$$\mathbf{y}_p = g_{\theta}(\mathbf{h}_p)$$



Sequence Classification



REFERENCES

- [1] Sepp Hochreiter and Juergen Schmidhuber. Long short-term memory. In Neural computation, 1997.
- [2] <https://www.tensorflow.org/tutorials/recurrent>.
- [3] Kai Sheng Tai, Richard Socher, and Christopher D. Manning. Improved Semantic Representations from Tree-Structured Long Short-Term Memory Networks. In ACL, 2015.
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language tasks." In NIPS Deep Learning and Representation Learning Workshop, 2014.
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- [5] Chung, Junyoung, Caglar Gulcehre, Kyunghyun Cho, and Yoshua Bengio. "Empirical evaluation of current neural networks on sequence modeling." In NIPS Deep Learning and Representation Learning Workshop, 2014.
- [6] <https://github.com/aymericdamien/TensorFlow-Examples>.
- [7] <http://web.stanford.edu/class/cs20si/syllabus.html>.

Learning Resources

- NLP conferences.
 - ACL, EMNLP, COLING, NAACL, EACL ...
- NLP online courses.
 - [Assignment Project Exam Help](http://web.st)
 - [Add WeChat edu_assist_pro](http://www.c)
 - <https://eduassistpro.github.io/>
- ML online courses.
 - <https://www.coursera.org/course/ml>
 - <https://www.cs.ox.ac.uk/people/nando.defreitas/machinelearning/>
 - https://www.youtube.com/watch?v=SGZ6BttHMPw&list=PL6Xpj9I5qXYEcOhn7TqghAJ6NAPrNmUBH_